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SIR CHARLES WHEATSTONE.

SIR CHARLES WHEATSTONE died in Paris on the 19th ult., of congestion of the lungs, aged 73. No more prolific and untiring mass of human ingenuity has lived during the present century than Charles Wheatstone. He was in harness till the very last. He was visiting Paris to watch the inauguration of his latest feat in telegraphy —the automatic system — between that city and Marseilles, when he was seized with his fatal illness. His loss will be severely felt, and his well-known figure missed from many a pleasant scientific gathering. There is scarcely a branch of physics that has not been graced by some pretty experiment and illustrated by some ingenious apparatus of his; but it is in the field of electricity where his fame will chiefly rest. His share with Sir William Cooke in introducing the needle system, his A B C apparatus, his automatic system, and his clocks will leave a name behind which will always place him in the very front rank of the useful benefactors of this ingenious age. Our readers will profoundly regret his loss. He was buried in Kensal Green Cemetery on the 27th ult., surrounded by a large gathering of his scientific compatriots and brothers in arms.

NEW ZEALAND TELEGRAPHY.

THIS growing, enterprising colony has again put forward a satisfactory and prosperous report of its telegraphic operations during the year ending June 30th, 1875. The revenue was estimated at £55,000, but it has exceeded that amount by over £800. During the year 917,128 telegrams of all codes were transmitted, being an increase of 164,299, or more than 17 per cent. over the previous year. There is a balance of £9,460 13s. 4d. as interest upon the capital expended.

The number of telegrams transmitted during the year (917,128), compared with the number of inter-provincial letters posted during the year, shows that 22·59 telegrams were sent for every 100 letters posted. The proportion is not quite so great as last year, but the fact that there is nearly one million increase in the number of letters posted as compared with the number of letters for the previous year will account for it.

To enable masters of vessels to ascertain the state of the weather prevailing at any port to which they might be bound, or at any intermediate port, the system of sixpenny telegrams, including reply, has been introduced. The facilities thus afforded, when generally known, will doubtless be taken great advantage of by maritime men.

A like facility for obtaining news at a reduced rate was also granted to all Chambers of Commerce throughout the colony, who might be desirous of acquiring for public information the arrivals and departures of shipping at the various ports. The consideration in this case asked for by the department was, that telegrams containing shipping intelligence, the same being positively for public and not private information, be paid for at the rate of 3d. per telegram for each vessel. This concession has not as yet been taken great advantage of, but will doubtless, with the general progress of the colony, be adopted to a considerable extent.

During the past year 456 miles of new lines, carrying a single wire have been erected, and 988 miles of wire have been added to the original lines, making a total addition of 1,144 miles of wire. There are now opened to the public throughout the colony 127 stations, 21 of which have been opened during the past year, 6 being in the South Island and 15 in the North Island. The length of line maintained during the past year was 2,955 miles, the average cost for maintenance being £4 16s. 4d. per mile. At the close of the year 2,986 miles of line, carrying 6,626 miles of wire, were in circuit, showing an increased mileage upon the previous year, of line 456 and of wire 1,444. The nominal strength of the department, including linemen and inspectors, on the 30th June, 1875, was 509, against 388 of the previous year.

The duplex system of telegraphy has been in successful operation on the No. 3 wire in the Cook Strait Cable since the 18th of June, 1874, and the advantage of speedy communication consequent thereupon has been very obvious. Instruments are now ready, and the system will be immediately introduced on the No. 3 wire north to Napier, and on the No. 3 wire between Blenheim and Christchurch. With the additional wires erected between Napier and Wellington, it is anticipated that this will greatly facilitate the transmission of the increasing work now offering.

It is proposed to introduce shortly the Automatic system on some of the longer circuits, instruments for this purpose having just arrived from England. In the transmission of long press messages, which may possibly require to be sent in various directions, the saving of labour cannot be over-estimated. It is proposed to lay a second single wire cable across Cook Strait, so as to have an alternative line in the event of the existing cable breaking down.

ON A SYSTEM OF TELEGRAPHY.

A Course of Lectures, delivered at the School of Military Engineering, Chatham, By W. H. PREECE, Member Inst. C.E., &c.

Lecture II.—A System of Telegraphy as applied to Commercial Purposes.

(Continued from page 233.)

As an illustration of what can be done by its means (the automatic system) I will take Mr. Bright's speech delivered at Birmingham recently. Twelve Wheatstone circuits in the place of the one usually at work were fitted up at Birmingham, communicating direct with 32 different towns grouped in this way—

Birmingham. Darlington. Newcastle. Edinburgh. Dundee.

160,000 words, equal to 80 columns of the *Times*, were actually transmitted over the wires, and 500,000 words were actually delivered, printed, and published. The transmission of the speech commenced within ten minutes of Mr. Bright's rising to address the meeting, and finished to all stations by 2 a.m. Only one strip was punched, which passed through each transmitter successively.

Although a wire worked with the Morse apparatus has transmitted on an abnormal occasion, with specially skilled operators, 82 messages per hour, and it *could* maintain this speed, the average over the system is not more than from 30 to 35 messages per hour. The Automatic, on the contrary, could transmit experimentally 300 messages per hour. The rate of working, however, varies very much with the distance between the stations. It is quite possible, on short lines, to send at the rate of 200 messages per hour, or even more, but when we use long wires, suspended in the air, buried in the earth, or submerged in the sea, electrical embarrassments due to induction are introduced, which materially diminish the speed of transmission. Between London and Manchester as many as 174 messages have been sent in the hour, but the average rate of working is 120; between London and Sunderland it is 90; between London and Aberdeen 60; and between London and Dublin 55. Generally it may be said that the Automatic apparatus has doubled the capacity of all our long wires, and quadrupled that of our shorter ones, and there is no doubt that it is capable of much further improvement and development.

All the messages have to be prepared by manual labour, and punching cannot be done at a greater rate than 45 words per minute. Hence delay occurs in preparation, and errors in punching, and this to some extent limits the utility of fast apparatus for ordinary short public messages. For "news" it is, however, invaluable.

It is also invaluable when a sudden glut of work is handed in, or when the ordinary communication is interrupted through storms and accidents; but it cannot be employed as a rule economically under distances of less than 200 miles, for within that distance it is cheaper to erect extra wires to improve the circuit capacity.

On long lines a limit is reached where the rapidity of hand manipulation equals that of mechanical manipulation; but automatic work still maintains its clearness, accuracy, and regularity. Great efforts are now being made to improve the rate of receiving, and some astonishing experiments have been made between London and Liverpool, though nothing practical has yet been gained.

The A B C is the simplest of all forms externally. It consists of a dial, upon which the letters of the alphabet are placed, and before which a pointer, propelled by currents, is rotated, stopping at the letter which is required to be indicated. Words are spelt directly, letter by letter. Any person who can read and write can send and receive messages by it. The earlier forms were crude and rough, but the teachings of experience have led to great refinements in workmanship and beauty of mechanism: and, as a finished piece of apparatus, there are few instruments to surpass Wheatstone's A B C.

Its rate of working is slow. Very expert manipulators attain twenty words—but the average does not exceed four or five words per minute.

It is very delicately constructed, and very liable to get out of adjustment; but it has the great advantage that it is worked without batteries; and it is supplied with an alarm, which is most useful in attracting attention in offices where messages are few and far between.

The Hughes printer records its messages in bold Roman type, upon slips of paper, which are delivered to the receiver of the message. It is a very fast working apparatus, and has recorded as many as 54 words in the minute. It dispenses with writers, and, therefore, only employs one clerk at each end. Though very accurate, it is very costly, both in construction and maintenance; and it necessitates the employment of the most intelligent and experienced class of clerks at each end, as well as the convenience of a workshop to conduct repairs rapidly.

The Bell Telegraph is an acoustic instrument, which transmits its indications by transient audible signals, differing in tone. There are two bells of different notes: the one operated by currents in one direction, the other by currents in the opposite direction. The one signifies a *dot*, the other a *dash*; or the one corresponds with the movements to the left side of the single needle, and the other with the movements to the right side. It is very rapid in its working; 40 words per minute is a common speed. The receiving clerk writes his own message; his eye is confined to what he commits to paper—his mind is free to follow the sense of the message; and he is simply in the position of being addressed by a clerk—perhaps two hundred miles away—who dictates each word, not as it is spoken, but as it is spelt.

But the instrument is complex in its construction (it cannot be worked with double currents), and though there are many great advantages attached to it, its continuance has been doomed, and it must gradually and inevitably retire before its more fitting rival—the *Sounder*.

The Sounder transmits its indications by transient audible signals, differing in *duration*. It is, in fact, a Morse recorder, bereft of its clockwork and its paper. A sharp stroke, delivered on a species of sounding-board—equivalent to a crotchet in music—is a dot, and a prolonged sound—equivalent to a minim—a dash.

It is the simplest possible form of apparatus; it is light and portable; it contains no mechanism: it is simply an electro-magnet, with its armature and antagonistic spring; it is an alarm, and is as rapid as the Bell, and it can be read faster than any writer can write; it is more accurate than any other form of instrument dependent on transient signals, for it involves accurate and careful sending, and can only be manipulated by experienced and well-trained clerks. The ear guides the hand in manipulation, and the clerk trained to read by ear must necessarily become an accurate sender. It is for this reason that I contend that the proper plan to train a Morse clerk is to teach him first of all to read by sound only, and not allow him to attempt to send until he can read well. By teaching him to send first he acquires bad habits, which are frequently very difficult to unlearn.

The sounder instruments, being so simple, are easily kept in order, and they consequently very rarely fail. It is a very conversational form of instrument, and it thus enables errors to be rapidly corrected and repetitions instantly obtained. The ear is not so easily tired as the eye, hence it is a favourite with the staff. Moreover it does not try the eyes or injure the eyesight.

It has supplanted all other forms of instrument in America, but it has until recently been but little used for general work in Europe. It is being rapidly introduced by the Postal Telegraph Department.

The instruments found in use at the transfer were the A B C, the Needle, the Bell, the Morse, the Wheatstone (Automatic), and the Hughes printer. It was intended originally to employ the *single needle* upon all sub-office circuits, and the *Morse* upon all head office circuits, but Morse clerks were scarce, and their training occupied much time, hence single needles were necessarily employed at the head offices because the clerks existed, but they could not be found in sufficient numbers for the sub-offices, and the anticipated business would not pay for the employment of skilled labour. Thus the A B C forced itself upon the department. The Bell was necessarily retained, for an army of clerks trained in its use were transferred to the service. The automatic and Hughes were but sparingly in use, but the merits of the former have thrust it into very prominent employment, while the latter has made little or no headway.

The stations which were to be provided with apparatus were:—

The small village *sub-office*, where the ancient grocer and his wife, as a reward for some past political service, were allowed to dispense stamps and butter, issue money orders and cheese, sort letters and herrings, dispatch mails and soap. The counter was cleared of its lard, its scales, its parcels, and its stinks, and a portion parcelled off to receive the wonderful telegraph. Many timid villagers dreaded the trial, and resigned their appointments; others sickened under the prospect of its arrival. Some declined altogether to have anything whatever to do with it.

What business was anticipated? Possibly a message a week, may be a message a day. This at 1s. would not pay for a skilled clerk, and the 1d. per message perquisite did not open the road to fortune. The village government representative must either work the instrument himself, or his wife, or his maid.

To teach him the Morse was hopeless, to acquire the needle was equally so. There only remained the A B C, and this instrument seemed specially ordained for such a case. Hence small post-offices were worked with the A B C, and were it not for the engineering difficulties involved in its maintenance, no more fitting instrument could have been devised for such a purpose. But it is troublesome to keep in order when fixed on crowded circuits in spite of its beautiful mechanism and exquisite construction.

As the business of these small sub-offices increased, or as the population and dimensions of the village approached the importance of a town, the number of messages became sufficient to employ skilled labour, and too numerous to be despatched without delay upon the A B C circuit. Single needles were employed. The office is perhaps in some small linen-draper's establishment, where a side room is portioned off for postal and telegraph work. The young ladies of the house attend to the general business, one is apportioned to attend to the telegraph duties. She speedily masters the instrument, and the natural qualification of the sex renders her especially adapted to attend to the telegraph business of the office. There is scarcely any duty more adapted to the peculiarities of the female temperament than that of telegraphy. Her sedentary habits, her homely quiet ways, her patience, and her industry secure her unremitting attention, and nowhere are the telegraph duties more efficiently performed than in those small towns where the work is just sufficient to occupy her attention.

The opponents to the transfer of the telegraphs to the State sneered at the village postmasters and postmistresses, and pronounced them totally unfit to be employed as telegraphists. I am bound to say that I shared in the doubts as to their efficiency. The postal authorities themselves scarcely expected the sub-postmasters to be as attentive or as proficient as established clerks. Experience has refuted all these surmises. The work of the small offices is better done than it ever was in the railway and smaller offices of the Telegraph Companies, and though I do not pretend to say that the service is perfect, for we cannot expect experience and technical knowledge behind the small tradesmen's counters; I do say that it is better done now than it ever was before, and the amount of zeal, earnestness, and energy displayed for such small remuneration is a source of never-ending surprise.

Such offices ruled by sub-postmasters or sub-postmistresses are always subservient to some larger office, called the *head office*, presided over by a regular appointed postmaster. They cluster around these head offices in groups, and all the messages for such offices circulate through their head office.

Circuits are formed, embracing not more than three or four offices in the case A B C's, and five or six in the case of needle circuits.

The head offices in the smaller towns are generally in some tradesman's shop—the chemist or the bookseller—who screens off a portion of his space for the postal and telegraph work; but in all the larger towns where the business justifies it, special premises are devoted to this work, and a regular established postmaster appointed. At one office the postmaster keeps a regular *omnium gatherum*.

On one side is advertised "Post Office, Money Order Office, Savings Bank, Postal Telegraph," and on the other "Pickles, Cattle Medicine, Perfumery." The postmaster controls and supervises all the sub-offices under his charge.

The head offices are placed in direct communication with each other, and with the chief centres, such as Manchester and Birmingham, which again in their turn are connected with the chief telegraph station in London, known as T S, so that messages are sent from place to place by the most direct routes, and every office is provided as much as possible with alternate circuits or double outlets in cases of accident or pressure.

The system before the transfer of the telegraphs to the State was mainly directed to place London in communication with the Provinces, but the Post Office has placed all towns that have business relations in direct communication with each other, and has diverted as much as possible the circulation of messages through London. It has done all in its power to prevent the unnecessary repetition of messages, and to reduce the number of transmissions to the fewest possible, for every transmission means increased cost in working and extra liability of error.

All head offices as a rule are worked by Morse circuits; some few still remain worked by needle circuits, but gradually, as the business increases, the needles are being supplanted by the Morse and the Morse by the sounder. Where several offices remain on one circuit, the needle is retained, but intermediate working induces delay, and as soon as the business admits of it, direct wires, fitted with Morse instruments, are supplied. Head offices are almost invariably worked by trained telegraphists, either in the employment of the postmaster or directly in the service of the Crown. All the large transmitting centres are worked entirely by a trained and experienced staff, under the direct control of the postmaster of the town in which it is placed.

It may be taken as a rule that, when the messages are very few, A B C instruments are used. When the number of stations on a circuit exceeds four, or when the number of messages exceeds twenty per day, then single needles are fixed. As the business increases the single needles are replaced with Morses. When the number of messages exceeds fifty per day it is time to consider the necessity of a direct wire. One such wire can transmit without delay 150 messages per day. If the messages approach 200 a day, another wire is wanted. If the distance between the stations and the amount of business warrants the expense, then Wheatstone's automatic is fixed, and this can readily transmit from 400 to 500 messages per day.

Recently duplex telegraphy, which enables messages to be sent simultaneously in opposite directions on the same wire, has been introduced. It simply duplicates the capacity of all *direct* wires, and it has placed in the hands of the Postal Department, a most valuable and useful auxiliary apparatus. Indeed without it, and with the recent stoppage of all works, it would have been difficult to have transacted all the work of the Department during the very busy autumn which has just passed, without inconvenience or delay. It is applicable to all kinds of instruments.

It may be said generally that the teaching of experience is showing that the instrument of the future for ordinary commercial work is the "sounder."

(To be continued.)

A NEW SYSTEM OF ELECTRIC TELEGRAPHY.

By PAUL LA COUR,
Sub-Director of the Meteorological Institution of Copenhagen.

(*Presented to the Royal Danish Academy of Sciences at the Meeting of February* 12, 1875, *by Mr. Holten.*)

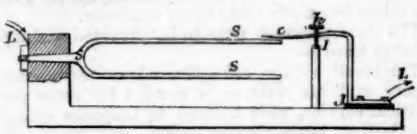
In the Electric Telegraph, up to the present time, but two simple signals have been employed, and these have been formed either by currents in opposite directions, or by the prolongation, to a greater or lesser extent, of the duration of the current. The system, which I devised on the 10th May last, enables, however, a large number of simple signals to be made with a single conducting wire.

When a vibrating body, at each of its vibrations, is made to close and open an electric circuit, the pulsations of the current will, of course, be isochronous with the vibrations of the sonorous body; and when such currents are, by means of electromagnets, made to act upon a second sonorous body vibrating in unison with the first, the second body will vibrate, whilst another similar body giving a different sound will remain silent.

The first experiment was successfully made on the 5th June, 1874, but it was feared that the vibrations might cease to be perceptible after traversing a long distance. I therefore made an experiment upon a telegraph line, 390 kilometres in length (from Copenhagen to Frederica and back), and even with a rather weak current, the pulsations were easily perceptible. This experiment was made during the night of the 14-15 November in the same year.

To produce the intermittent currents and receive them at the further end, the sonorous bodies employed were tuning-forks. The apparatus is constructed in the following manner:—

The key or instrument, which produces the intermittent currents in the line, is shown in the following figure:—



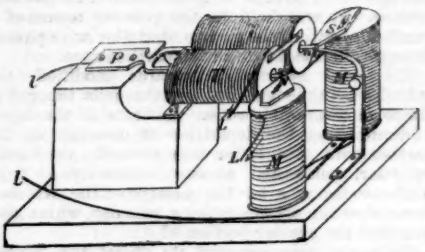
S S is a tuning-fork fixed by the shank in such a way that at each oscillation one of the prongs touches the contact *c* during a portion of the oscillation. The contact *c* can be adjusted by the screw *k*, and together with its support, is insulated from the tuning-fork by the insulating piece *J*.

When the shank of the tuning-fork is connected to one of the poles of a voltaic battery whose other pole is to earth, and when the contact piece is connected with the telegraph line and thence to earth, a blow given to one of the prongs of the fork will cause an intermittent current to be sent into the line, the pulsation of the current being in unison with those of the fork.

It follows that, by keeping the fork in vibration,

the same result will be obtained, whenever the circuit is closed at any given point. It always follows that, by employing a contact upon the inside of the fork with a special battery for the same, the line can be charged with a succession of currents in opposite directions.

The receiving apparatus is shewn in the next figure.



n p s is a tuning-fork of soft iron giving the same sound as that of the key. The prongs are inserted lengthwise in the two coils *T T*, which are surrounded by silk-covered copper wire; the prongs are so arranged as to vibrate freely within the centres of the coils. The intermittent current, on arriving at the station, passes through these two coils, and thence into the wire of an electro-magnet *M M*, which is arranged so that its poles are placed in front of the opposed poles produced in the fork. It is evident that the current, in magnetising the electro-magnet and the fork, produces an attraction which will open the prongs of the latter, but directly the current, and consequently the attraction, ceases to operate, the prongs will return to their position of equilibrium, and so on. If then the pulsations of the current are in unison with those of the fork, the vibrations of the latter will soon attain a sufficient extent for one of the prongs *n* to touch the contact piece *D*, closing the circuit *l l* of a local battery, and thereby manifesting the arrival of the current in the usual way, either directly or by means of a relay.

I cannot as yet, I admit, state the time required to produce in the fork of the receiving apparatus vibratoins of a certain extent; it is a function of various factors; but experiment shows that the time which elapses before the local circuit is closed is so small a fraction of a second as to be hardly perceptible, even when the current is very weak. In the hope that this system will play an important part in electric telegraphy, I beg to here point out its principal advantage.

The intermittent current acts upon that tuning-fork only which is in union with the fork of the key. If then any number of different keys are arranged and the same number of receivers to correspond, an equal number of simple signals can be produced, each of which requires but a single movement. If each of these signals corresponds to a letter, figure, or other sign, messages may be sent more quickly than by present methods, and the receivers can be made to act upon a printing apparatus without any difficulty.

The same peculiarity will admit of the employment of these signals where several stations are connected together by a single cable. A signal can be sent between any two of the stations without the others being aware of it. The system might also become applicable in various other circumstances, for example: to call, give warning, announce the occurrence of an accident, fire, torpedoes, &c., in a word in all cases where it is desired to transmit signals only to certain points.

Another important property of the system is that *several signals can be produced* SIMULTANEOUSLY *upon the same wire.* For when several keys are acted upon at the same time, the current thus produced, with simultaneous intermissions of different duration, will only act upon the receivers corresponding to the vibrating keys, if only the forks have been selected in such a way as to avoid simple harmonies between them. Thus, for example: by employing a system of ten tuning forks, ten simple signals can be produced, then $\frac{10 \times 9}{1 \times 2} = 45$ signals when combined two and two, without the latter requiring more time than the simple signals. The question of the limit to the number of forks which can be vibrating at the same time is one that can only be determined by experiment.

The same property makes it possible to transmit several messages to various stations, employing but one wire. For example; station A is connected by a wire with station B, whence the wire is continued to station C. Station A can use two different systems of keys, one for station B and the other for station C. The receivers at the two stations must, of course, correspond with the keys. The same property also enables the system to be employed for pantelegraphs of a more reliable and quicker form than those made by Bain, Caselli, and others. Up to the present time only one style has been used in such telegraphs, and this style has to pass over the whole surface of the telegram to produce a copy of it; in the new system, however, as many styles as may be desired can be placed side by side in the form of a comb, which will then pass over the surface of the message in one direction only. By this method also, there is the advantage that an exactly equal speed is not required in the two instruments, for the only inconvenience which would result from a difference of speed between the original and the copy would be a slight contraction or extension in width of the whole message.

Lastly, the receivers have the valuable peculiarity of *letting ordinary electric currents pass through them without any indication of their presence,* at least, unless the currents are of very considerable intensity, so that atmospheric and terrestrial currents would not, as a rule, interfere with the working of telegraphs arranged upon this new system.

ON TELEGRAPH CONSTRUCTION.

By JOHN GAVEY.

(Continued from page 238.)

Line Insulators.

THE two principal points for consideration in the selection of an insulator, are its form, and the material of which it is composed.

These have been varied in a multitude of ways, but certain definite principles can be laid down, which are of more or less universal application.

First, the electrical qualities require attention, the object being to obtain an insulator which op-

poses the greatest possible resistance to the passage of a current of electricity. Conductivity is possible either through the mass of an insulator or through a film of moisture or conducting material over its surface. To provide against the former, a material which as nearly as possible offers an infinite resistance should be selected. It should be homogenous, uniform in quality, and not porous, or in any way an absorbent of moisture. It should not deteriorate, crack, or split, by exposure to atmospheric influences, but should retain permanently the qualities sought for in its selection.

Surface conduction arises from the deposition of a film of moisture, or of the more or less conducting substances which float about in the atmosphere. The resistance of an insulator to loss from surface conduction depends primarily upon the form given to it, and in deciding this point, the ordinary law that the resistance of a conductor varies directly as the length, and inversely as the section, affords a guide as to the dimensions that should be adopted; any means by which the length of the insulator is increased and the diameter diminished increasing its resistance *per se*—the affinity for moisture, however, of the material employed, the smoothness and evenness of the surface, the readiness with which dirt adheres to it, and insects form their nests within the interior, and the facility with which the surface can be washed by rain, all tend to vary the results obtained with different forms and materials, and should all be carefully taken into account in considering the relative value of various forms employed by different services.

The materials used are varied, and the qualities to be sought for, in addition to those already specified, are sufficient tensile and compressive strength to withstand with success the greatest strain likely to be brought on them. They should be readily moulded or wrought into the desired shape, and should be tough and adapted to resist a certain amount of rough usage to which they will inevitably be subjected. Glass, stoneware, porcelain, ebonite, and wood impregnated with insulating compounds have all been used with various degrees of success. Glass was widely used in England in the early days of telegraphy, but the readiness with which moisture was deposited on its surface, and its liability to crack, caused it to be rapidly replaced by stoneware and porcelain, which are the two materials wholly used in this country. It is possible, however, that its use may be revived with great advantage if the electrical qualities of the toughened glass, of which so much has lately been heard, are at all comparable with its alleged mechanical ones.

Stoneware and porcelain, the former especially, are excellent materials for insulators. If selected with care, properly manipulated, thoroughly burnt and vitrified throughout their whole substance, they are proof against all ordinary vicissitudes except that of mechanical violence, to which unfortunately they are most subject. The materials are readily moulded into any desired form, and a clean, well glazed, thoroughly even surface is easily obtained. Ebonite, one of the most perfect of insulators as a mass, soon deteriorates over its surface, which becomes partly conducting through the adherence of dirt. Wood has been used as giving a substance which can withstand with impunity the stone-throwing proclivities of mischievous persons. The difficulty with this material, however, is to give it that thoroughly smooth surface which is of such importance to the continued efficiency of a line.

The earliest practical insulator that was used to any extent in this country simply consisted of a short cylinder of glazed earthenware, with a hole through its axis and a groove round its circumference. It was held to the pole by means of a small clip, fitting the groove, and the wire passed through the axial hole in the earthenware.

This was shortly afterwards modified, the cylinder being lengthened and the ends tapered in the form of a double cone. Later, with the object of diminishing the deposition of moisture on the earthenware, the latter was formed into a solid cylinder, perforated at one extremity at right angles to its axis for the passage of the wire, and covered at the upper end by a zinc cap, which surrounded the greater portion of it.

Although this achieved its object, the remedy was as bad as the disease, for the cap, without in itself impeding the escape of the current, fostered the accumulation of dirt and spiders' nests, so that the insulation left much to be desired.

This was followed by the umbrella-shaped insulator, known to old telegraphists as the "No. 3," which was a direct descendant of the last form, the zinc cap being replaced by an earthenware or glass one. This insulator did good service, but as the system extended, and longer lines became common, an improvement was found necessary. This was partly achieved by paying greater attention to the manufacture of the material, but the greatest advance was made in the form given to the insulator, which is a type of those now in use. This was introduced by Mr. Latimer Clark, who in 1856 patented his double cup insulator, which consisted of a double bell cemented on a bolt or stalk, by which it was attached to a bracket, the wire itself being supported by a suitable groove on the top of the insulator. Mr. Varley later improved on this by introducing an insulator in which a long narrow cylindrical cup was cemented inside of a larger one, so as to have a clear space between the two. A suitable bolt or stalk, to form an attachment to the pole, was fastened in the small cup, and the large one contained a circular groove near its upper end to retain the wire. By these means the mean section of the conducting surface was diminished, whilst the length was considerably increased. Further, by the use of two separate and independent cups, the additional advantage was secured, that a breakage or undetected defect in one of them simply reduced the effectiveness of the insulator, by say one half, instead of almost wholly neutralizing its insulating properties. For short lines single cup insulators, similar in outward form to the above two descriptions, are now used, but the former or modifications of the same principle are now employed on all important circuits in most countries.

Occasionally the insulators are protected against mechanical injury, by being covered with an outer iron cap. This, however, has a most injurious effect on the insulation, as it fosters the accumulation of conducting matter over the surface of the porcelain or earthenware, and impedes the beneficial action of rain, which in the ordinary type cleanses the exposed surfaces whenever it falls

heavily. To obviate this, perforated cups have been introduced, which, whilst protecting the brittle material from stones of a size to injure them, admit of the entrance of sufficient water during heavy rains to wash the insulators. Even these are, however, far inferior in insulating power to the ordinary unprotected form.

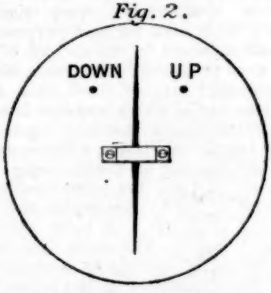
In testing insulators, they should be exposed to precisely the same influences as they will be subject to in actual practice, or fallacious results will be obtained. The minimum insulation resistance of an open line of telegraph in the worst weather, is generally taken at 200,000 ohms per mile. Thus, taking 30 insulators per mile as the maximum number which will be used at any time, a single one should not offer a less resistance than say 6 megohms after exposure for some months, and in wet and misty weather. Practically a higher result than this even should be given to counterbalance the effect of exceptional losses in the weak places which every long line exposes. Some years ago Mr. Culley, for the Electric and International Telegraph Company, inaugurated an exhaustive series of experiments on the value of various classes of insulators, which resulted in the adoption of the forms now in use in this country. Those who seek further details on the whole subject, are referred to his handbook, where it is treated of at length.

RAILWAY BLOCK SIGNALLING.

(Continued from page 218.)

To Mr., now Sir William Fothergill Cook, is the world indebted for the origin of the block system. In 1842 he produced a pamphlet, called "Telegraphic Railways," in which he suggested the principle of working which has been explained. His idea was to form the line into divisions of from 15 to 25 miles, and again to form these divisions into sub-divisions or sctions, of from 2 to 5 miles. Each station was to be provided with an instrument having upon its face as many indicators as there were sections or sub-divisions of the line, the indications made by the needle or pointer being two in number, viz., UP and DOWN (Fig. 2). On

Fig. 2.



an UP train entering—say section A B—B would, before allowing it to enter the section B C, set his indicator to "UP," at the same time ringing a bell at C. If the section was clear, C would pin over the handle of his indicator to "UP," and on the train passing B, B would release his indicator, which would indicate train had passed B. But one indicator would then be left open, viz., that belonging to C, and this indicating "UP," it would be seen by all stations in the division that an up train was running between B and C.

This system, although not complicated in its mode of working, was cumbersome and expensive. Judged by the present method of working block signals, it meant multiplying the number of instruments and wires at any one station by the number of sections composing the division; so that for a division of five sections, the cost would be something like twenty-five times that of the present system. It was, however, a great step in the right direction; and the railway world in particular, and the public at large in general, will ever remain indebted to Sir William F. Cook for the able manner in which he brought before the world that principle which is undoubtedly the only true and safe principle upon which railway traffic can be worked. Its first tral was on the Great Eastern Railway, between Norwich and Yarmouth, in 1844.

Further improvements were effected by Mr. Edwin Clark in his application of it on the London and North Western Line in 1854. Each set of rails had its own independent telegraph, by which the out-door signals were regulated. The instrument employed was that known as the "double needle."

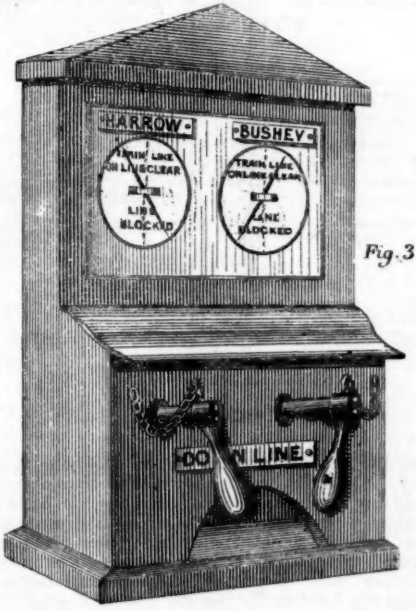


Fig. 3.

A deflection of the needle on one side, again indicating "line clear," and a deflection to the opposite side, "train on line," whilst the needle standing vertical indicated failure of instrument or the occurrence of an accident, and that the line was "blocked." The handles, by which the instrument was worked, were slotted in such a manner as to admit of their being pegged over either to one side or the other so as to give and maintain either of the indications named. Thus constant currents of electricity were always maintained on the wires either "for line clear" or "train on line."

At certain intervals the line wires were terminated on each side of the pole, and the circuit completed by a loop of small wire carried down the pole (fig. 4) so as to be within reach of the

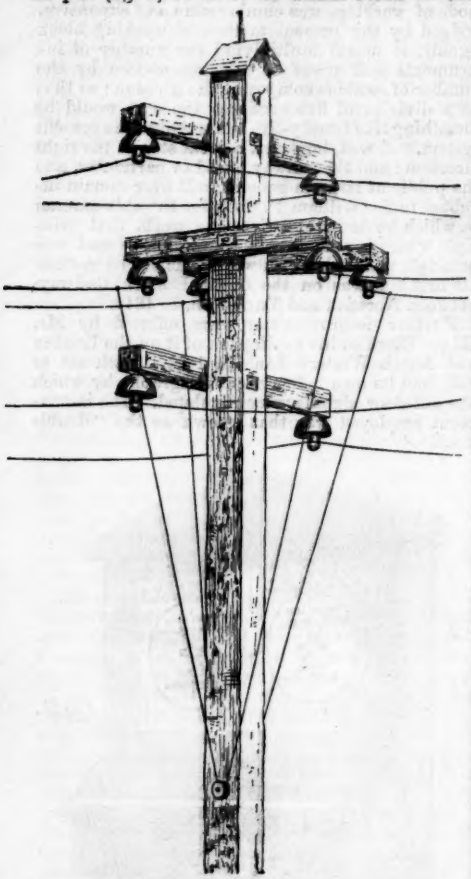


FIG. 4.

guard or any person standing on the permanent way. Should an accident arise, or it be necessary from any other cause to block the line, the cutting of these wires interrupted the circuit and produced the vertical signal indicating "line blocked." Though an ingenious contrivance it is questionable whether any advantage attended its adoption. From the fact that its use has not been extended, it may be inferred that if such was the case at the time of its introduction the necessity for it no longer exists. It is certain that in the confusion arising at the moment of an accident the chance of the wires being again joined by the guard—in accordance with the instructions—would be very slight. Not only do all such arrangements add greatly to the cost of construction, but they are a fruitful source of interruption, and at the best merely intimate, perhaps a moment or so earlier, that which the non-arrival of the train, or the absence of a signal to that effect would convey to the signal boxes at either end of the section. A question of still higher importance is moreover involved. The indication can be produced not only by the severance of the wire but by the failure of the battery; by the wire becoming in contact with other wires, or with the earth. A series of failures such as these would be likely to induce carelessness on the part of the signalman. He would conclude the failure was due to some defect with the apparatus rather than to an accident on the line, and become indifferent in his instructions to the engine-drivers of following trains to "proceed with caution." Anything which tends to reduce confidence in the signals in use, whether by its interference with their good and perfect working, or by inferences deduced from that or other causes, should be carefully avoided.

The Great Northern in adopting the telegraphic working upon that line of railway, although employing a similar form of instrument, applied to it a system inferior to that hitherto used. Both needles were used promiscuously for the up and down lines (fig. 5). "Train in" being indicated

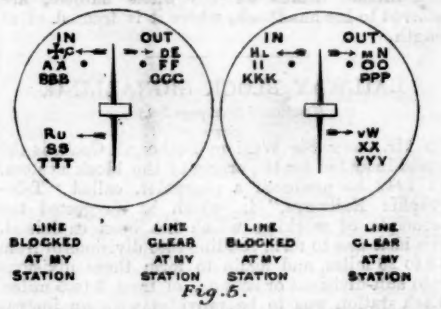


Fig. 5.

by one beat of either needle to the left, "train out" by the opposite motion; the signals "line blocked" and "line clear" being rendered by holding both needles over momentarily in the direction of those words. All signals were thus transitory or momentary, every signal being recorded in a book kept for that purpose.

The signals obtained by one and all of these instruments were produced by the same means, viz., a small permanent magnet fixed upon a spindle, to the extreme end of which was also fixed another needle, not magnetic, the spindle being so fixed as to admit of the magnet oscillating within a pair of coils. On the inner magnet or needle being influenced by the electric current, the outer needle repeated the movement, and thus conveyed to the signalman the indication required. Of more recent date is the induced magnet. The form described is objectionable from its liability to *demagnetization* or *reversal* of the magnetism of the inner needle by lightning. The employment of needles, the magnetism of which is induced by other magnets placed in their neighbourhood, is preferable; for although a false signal, as "line clear" when the line is *blocked*, may be, in this, as in some other instruments, produced by atmospheric electricity, it yet gets rid of the absolute *reversal* and *demagnetization* to which the old form of needle is subject.

MILL LIGHTING BY ELECTRICITY.

By A. TOLHAUSEN.

In spite of the many improvements which have been brought to bear on the various magneto electrical machines for the generation of light, the use of electricity for lighting up mills or other workshops in place of common oil or gas, has scarcely been introduced.

The "Journal für Gasbeleuchtung," however, recently observes that in the establishment of Messrs. Heilmann, Ducommun, and Steinlein, in Mühlhausen, electricity has been applied apparently with success for lighting-up purposes. In a separate room four magneto-electrical machines are placed, which feed other four suitably located lamps constructed on the Serrin principle. The dimensions of the room lighted up are 60 metres (196.8 ft.) by 30 metres (98.4 ft). Each lamp throws off a light equal to about a hundred Carcel lamps, and these are surrounded respectively by a glass globe which serves to blend the light intensity. The cost of the four lamps, excluding the maintenance of the motive power, averages about tenpence per hour.

During the three months which this electrical light has been working, no inconvenience has been experienced, the light given off being beautiful and steady, and uncomparable to any other mode of illumination. The magneto-electrical machines have each cost 1,500 frcs., or sixty pounds sterling, the whole arrangement amounting to 8,000 frcs. or £320.

With regard to the comparative cost of this electric light, with other means of illumination, M. Laboulaye furnishes the following table:—

	Quantity of material required for producing light = 1 stearine candle.	Cost of a light-intensity = to that of 700 stearine candles per hour.
Electrical light obtained by a magneto-electrical apparatus	.. ..	1s. 2d.
Ditto galvanic pile ..	.. ..	2s. 6d. 4s. 2d.
Coal gas	0.53 cub. ft.	2s. 8d.
Oil (vegetable) ..	79.92 grains.	5s. 1d.
Tallow candle.. ..	162.02 ,,	10s. 6d.
Stearine	160.47 ,,	21s. 10d.
Wax	127.45 ,,	27s.

In the preceding table the following prices have been assumed: gas, per cubic meter = 3d.; tallow, 17d. per kilogramme; stearine candles, 3s. per kilogramme; wax candles, 4s. 2d. per kilogramme.

To distribute the effect of the electric light in various directions and points in a uniform manner, the attempt has been made to pass the current through the different apparatuses by means of current deflectors, which break the currents passing through the lamps during so short a period, as to make the light appear to all intents and purposes as being continuous. The fact has been hereby utilised, that the impression made by light upon our visual organ remains intact during at least one-tenth of a second's duration. Moreover, the luminar arc between the carbon points becomes momentarily reproduced, provided the current interruptions are only of minute duration, a fact which has been repeatedly proved by the illuminating apparatuses of Siemens and Halske, as of late improved by Häfener Alteneck. Leroux has himself determined by experiments that the luminous arc between the carbon points becomes instantaneously reproduced provided the interruption of the current does not exceed one-twentieth of a second. This last-mentioned authority also succeeded in dividing the electrical light, by employing a rapid turning deflector, by means of which he alternately conducted the current of a Bunsen's battery to two lamps, in such a manner that each of these received an equal amount of currents in equal times; the luminosity given out by these was also equal in both lamps.

On the other hand, it would appear that this *modus operandi* is neither cheap nor practical, and it has therefore been further attempted to divide the electric light without having recourse to the luminous arc. The results, however, have not been satisfactory, inasmuch as the cost of such illuminations rank almost equal to those of gas or petroleum-lighting. These futile attempts induced Gramme to construct smaller machines with an equivalent light intensity of fifty Carcel lamps. These small lamps work very well alone; the light emitted is not perfectly steady; the best of the machines yet introduced, present a light of at least one hundred carcel lamps, with an average cost price of £60.

Although the foregone description does not solve the problem concerning the divisability of the electric light, it is possible that the modern improvements made in this direction, coupled with the reduced cost, may at no distant period lead to the lighting up of our mills, railway stations, &c., by means of electricity.

Correspondence.

TO FIND THE INTERNAL RESISTANCE OF A BATTERY AND ITS ELECTROMOTIVE FORCE AT THE SAME TIME.

To the Editor of the TELEGRAPHIC JOURNAL.

SIR,—The following expeditious method of finding the internal resistance of a battery and its electromotive force at the same time was devised by me last November. I now send it to you for publication in the hope that it will be as useful to many of your (practical) readers as it has been to myself. After several months' experience, I can recommend it as extremely accurate. It assumes nothing as known, as is the practice in most other methods.

A B Fig 1, is a set of resistance coils, most conveniently that arrangement known as "Thomson's Slide." C is any resistance, but if possible it will be preferable to make it approximately equal to R, the internal resistance.

Having connected the apparatus, as shown in the figure, the resistance A B is varied until the galvanometer shows no deflection. When this is so, the potential at the point P is equal to that of the standard cell or battery e (*vide* page 18 Clark's "Electrical Measurement;")

$$\text{therefore} \quad \frac{(A+B)E}{A+B+C+R} = e \qquad (1)$$

Now depress the key K, and, if the galvanometer needle be deflected, slide the travelling peg, to which the fron contact is attached, to or from the point P until the needle returns to zero. Let this be the case when the peg is situated as shown above. Then since balance is

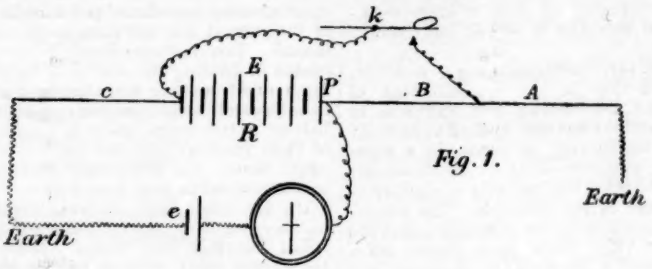


Fig. 1.

undisturbed the potential at P must still be equal to to that of the standard cell;

$$\text{therefore } \frac{BE}{B+R} = e \qquad (2)$$

Combining equations 1 and 2, we get

$$\frac{(A+B)E}{A+B+C+R} = \frac{BE}{B+R} \qquad (3)$$

whence we obtain the formula

$$R = C\frac{B}{A} \qquad (4)$$

or in another form A : B : : C : R.

Now knowing the valves of A, B, C, and R $\left(= C\frac{B}{A}\right)$ and knowing also that the potential at P = e, we can find the electromotive force E by the rule of similar triangles given at page 20 of Clark's work above mentioned—thus

$$E : e : : A+B+C+C\frac{B}{A} : A+B$$

or simply $E : e : : B+C\frac{B}{A} : B$, therefore

$$E = \left(1+\frac{C}{A}\right)e \qquad (5)$$

Practically, and as an aid to the memory, Fig. 1 may be drawn thus.

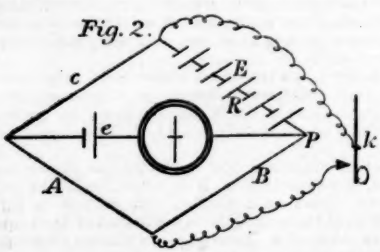


Fig. 2.

I need hardly remind your practical readers that, in order to avoid polarisation of one battery by the other, the connection of the galvanometer with the larger battery and the depression of the key K should be momentary *until* balance of the needle is obtained in each case.

I may, however, mention that the internal resistance of a battery whose positive plates are "dirty" (as will be the case more or less with all batteries which have been at work some time) is very variable. True, this variation is generally very small, but it must not be neglected, for, since it makes R a variable quantity which *may* alter during the later portion of the test, E must also be variable to a propotionate extent. When therefore great accuracy is aimed at in determining the electromotive force of a battery, care should be taken that the positive plates are clean, and that their immediate surroundings contain no metallic substance in solution, or otherwise foreign to the plates themselves.

Shiraz, Persia, J. J. Fahie.
July 5th, 1875.

To the Editor of the Telegraphic Journal.

Dear Sir,—In No. 59 of your Journal, July 15th, 1875, I find a system of Quadruplex Telegraphy described by Mr. Kempe, which is a modification of that invented by Stark of Vienna. Now I have tried every one of the so-called devices for the transmission of two messages in the same direction at the same time, described by Düb, Schellen, Blavier, and others, including also Mr. Kempe's, and will say that not one of these will allow of the transmission of a single word, and a very small amount of experimenting will make this evident.

It seems to me to be a real shame that such theoretical devices are put in standard telegraph works to be brought out against future inventors as an evidence of priority.

Respectfully yours,
Charles Batchelor.

16, Ward Street, Newark, N.J., U.S.A.
August 20th, 1875.

Notice to Correspondents.

We have received an angry letter from Calcutta respecting some remarks made in our impression of August 15th, in reviewing the Journal of the Society of Telegraph Engineers. As our correspondent simply questions the judgment of our reviewer, we regret we cannot publish his letter.

F. W. Young.—The sound made by the wires is due entirely to the moving air. It has nothing whatever to do with currents. Currents do not produce sounds in wires.

W. Tyrrel.—The book is now in the press, and may be expected very shortly. Mr. Kempe's papers, with corrections and considerable additions, are about to be published by Spon and Co.

Notes.

The *Hibernia*, with the second portion of the New Zealand cable, will leave in the early part of November.

The cable between Santos and Santa Catarina having been repaired, direct telegraphic communication with La Plata is now restored.

The Government of Western Australia propose to expend £28,500 in the construction of a line of telegraph to South Australia. The line will extend from Albany to Eucla.

We are happy to announce that Mr. F. C. Webb, C.E., who has lately returned successful from cable operations on the Brazilian Coast, has had conferred on him by the Emperor of Brazil the honour of a Knight Officer of the Order of the Rose.

Magnets prepared by compressing iron filings in tubes have been exhibited to the French Academy by M. Jamin. When soft iron filings are forcibly compressed by hydraulic pressure, they acquire a coercive power equal to that of steel.

It is semi-officially announced that the subcommittee of the Western Union Telegraph and the Atlantic and Pacific Telegraph Companies have agreed on a plan for a consolidation of interests, and that it is to be submitted to the respective board of directors.

The Indo-European Telegraph Company state that the average time in transit between London and India, *via* Teheran, of all outward messages to India, including messages for Penang, Singapore, China, Japan, Java, and Australia, during the week ending 22nd October, was 51 minutes.

The New South Wales Government have successfully adopted the Wheatstone Automatic System. Mr. C. E. Winter has just returned from Sydney, where he has been engaged in starting the system and instructing the staff. He brought away with him the warmest congratulation of the Postmaster-General.

The liquidator of the Panama and South Pacific Telegraph Company, Limited, announces that all the moneys owing to the company having been collected, he is enabled to declare a further return of 15s. 9d. per share to those shareholders who have paid up £2 10s. per share, and a return of 7s. 2d. per share to those who have paid only £1 per share, being the proportion due to them after deducting interest at the rate of 5 per cent. on the allotment money due the 31st January, 1870, not paid by them.

A curious statistical table has been drawn up in France showing the distribution of letters and telegrams per head in different countries. Switzerland is first in both classes, the telegrams averaging eight for every 100 inhabitants; in France there are 23 letters to every 100 inhabitants; in England 20 1-12th, and in the United States 19. In England there are 54 telegrams for every 100 inhabitants; in Holland 51; in Belgium 47; in the United States 32; in Germany 31. France ranks tenth, and Russia last with one.

The harmonic-electric telegraph invention (now commonly known as the telephone) of Mr. Elisha Gray, of Cleveland, is undoubtedly destined to prove a very useful and important one. On Friday of last week we saw four despatches transmitted simultaneously from Boston to this city, on one of the Western Union wires. It is believed, and with good reason, that at least sixteen messages can by this invention be transmitted simultaneously over a single wire. Mr. Gray has made a discovery and invention which will be likely eventually to revolutionise the present Morse telegraph system. (*The Telegrapher*).

Superintendent C. G. Merriweather, of the fourth district in the Southern division of the Western Union Telegraph Company, reports that the experience of the past season has proved conclusively that the application of lightning rods to telegraph poles is a matter whose importance should lead it to receive careful attention. On many routes under his charge, where a large number of poles were formerly destroyed by lightning every year, a dozen or more being sometimes shattered in a single day, the attachment of lightning rods has resulted most favourably, not a single pole having been damaged during the present season. He also states that no trouble has been experienced from accidental contact between the lightning rods and the line wires, although serious apprehensions were entertained that this would prove an obstacle to their successful use. The rods were placed on every tenth pole, and also on the nearest pole on each side of every office. (*Journal of the Telegraph*).

ON THE ACTION OF MAGNETS ON RAREFIED GASES IN CAPILLARY TUBES RENDERED LUMINOUS BY AN INDUCED CURRENT.

By J. CHAUTARD.

The spectral modifications produced by the action of magnets on the light of an induced current traversing rarefied gases are subject to very complex laws; and it is only possible to formulate them after varied and long-continued experiments. M. Trève, in a Note published in the *Comptes Rendus* (January 3, 1870), after indicating some facts bearing on this class of phenomena, concluded in these terms—"coloration and decoloration of the gases under the action of magnetism, in the capillary parts of the tubes containing them;" but the experi-

ments of the accomplished officer were not very numerous, they were made on only a few gases, and appeared to be only indirectly connected with the researches he had undertaken. The subject seemed to me sufficiently interesting to be the object of a fresh study, of which I have to-day the honour to present to the Academy a rapid summary.

Conditions of the Experiments.—Without returning to the experimental arrangements indicated in my first Note*, I shall briefly analyze those which have permitted me to extend, and at the same time give a precise account of, my fresh experiments. These are:—the nature, temperature, and pressure of the gas; the intensity, direction, and source of the induced current; the action of the magnet through the form of its poles, the energy and direction of the magnetization, the distance of the armatures, and the axial or equatorial position of the tube containing the gas †.

(1) The rarefied gases or substances on which my experiments have been made are hydrogen, nitrogen, oxygen, carbonic acid, carbonic oxide, bicarburetted hydrogen, sulphur, selenium, iodine, bromine, chlorine, sulphurous acid, fluoride of silicium, bichloride of tin. All of them are far from presenting very pronounced modifications, as I shall presently show; the substances of the chlorine group are those most sure to succeed, and produce the most brilliant results.

(2) Elevation of temperature lessens the effect produced by the magnet. This can be ascertained by causing the induced current to pass for some time within the tube: the heat resulting soon weakens and sometimes renders inactive the magnetic influence.

(3) The pressure of the gas interferes with the action of the magnet to such a degree that it is possible with the same substance to obtain, according to the conditions, either the sudden cessation of the induced current, or a notable modification in the luminous appearance, or the permanence of the initial tint.

(4) By varying the intensity of the induced current, effects can be obtained similar to those which result from varying the pressure of the gas: in general, the more feeble the initial intensity, the more decided are the magnetic luminous modifications.

(5) The phenomena are the same when the induced current is derived from a Holtz machine or a Ruhmkorff induction-coil.

(6) Both directions of the induced current, as also of the magnetization, give pretty nearly identical effects; certain substances, however, seem to undergo a more energetic influence at the moment of the reversal of the current.

(7) In the form of the armatures, the surface ought chiefly to be considered; this should be plane, and such that the capillary tube will be embraced over the greater part of its length.

(8) It is evident that the more energetic the magnetization, the more pronounced will the phenomena be; it is usually determined with the aid of a pile of 12-15 Bunsen elements (large pattern).

(9) Lastly, the action diminishes rapidly with distance; this is ascertained by gradually removing the tube to about ½ centim. from the poles; beyond that limit the influence of the magnet ceases to be manifest.

Conclusions.—(1) The first result to be noted is an increase of resistance of the part of the induced current under the influence of the magnet. This resistance is sometimes such that the current may be suddenly interrupted at the instant when the magnet begins to act. This is made evident in the following manner. A tube is taken formed of two parts in communication, one of them presenting a constriction, the other a different length and diameter. The capillary part is placed in the pole of the electromagnet, after which the current of the coil is started. As long as the magnet is inactive, the light circulates uniformly in the two tubes; it is suddenly arrested in the shortest and narrowest at the instant when this is submitted to the action of the magnet. The effect can be produced with chlorine, iodine, sulphur, selenium.

(2) This cessation of the induced light caused by the magnet can be determined, with the same gas, in two quite distinct cases—either when exhaustion has been carried so far that the induction-current is near the limit which no longer permits it to pass, or, on the contrary, when the tension of the gas is sufficient for the spark to be near the same limit.

(3) Under the magnetic influence the luminous thread, when it persists, undergoes in capillary tubes a narrowing which can sometimes be perceived by simple inspection. This narrowing is produced by an augmentation of resistance, sufficiently energetic at times to be accompanied by a change of tint in the tube, or even by a modification of the spectrum. In certain gases, such as hydrogen, nitrogen, carbonic acid, the influence of the magnet is hardly perceptible, and the modifications observed enter into the system of the primitive lines.

(4) This narrowing, or the change of tint of the luminous thread, does not extend to more than half a centimètre from the poles: thus on taking a tube of sufficient length, by changing the height of the spectroscope while the magnetization is going on, the normal spectrum (that produced by the light outside of the magnetic field) and the spectrum modified by the vicinity of the magnet can be successively seen.

(5) In order to form a good judgment of the action of the magnet, it is necessary to manage so that the spectrum is not very bright at starting. As soon as the current passes in the electro-magnet, the lines appear in all their splendour. The phenomenon is particularly successful, and gives the most perspicuous results with chlorine, bromine, chloride of tin, fluoride of silicium, and sulphuric acid.

(6) Direct measurements have proved that, for these last substances, the new lines developed under these circumstances are distinct from those which characterize the normal spectrum of the same gas traversed by a sufficiently energetic induced current outside the range of a magnet.—*Comptes Rendus de l'Acad. des Sciences*, vol. lxxx. pp. 1161-1164.

* *Comptes Rendus*, Nov. 16, 1874, p. 1123.

† The form of my apparatus has not, up to the present time, enabled me to compare the effects resulting from these two positions.

Improvements in Private Telegraphy.—Mr. R. S. Symington, of Glasgow, has just added another to the various novel and useful adaptations of the systems observable in various parts of the above city. Inside the lobby of the Royal Exchange has been erected a small office or enclosure labelled "Members' Private Telegraph Inquiry Office," inside which Wheatstone's alphabetical telegraphic instruments have been set down, having in connection with each switch, by which the current may be directed to any one of the twenty-five different wires. This switch may be described as an ebonite stand of circular form, having round the outer rim a series of twenty-five brass terminals to the wires, and an inner series of knobs of indicators. In the centre of this inner series is a handle, by turning which the current is directed to the particular wire through which the clerk in attendance is desired to convey a message. These wires are connected with the offices of all the members, and by this means the various business firms are placed in communication with each other and with the Exchange. On the receipt of messages at the Exchange they are posted by the clerk in a conspicuous part of the room, and a bell is rung to inform members of the fact. The messages are placed within a large case, divided into numbered pockets with glass in front; and as each member knows his own pocket, a glance shows whether the message is intended for him.